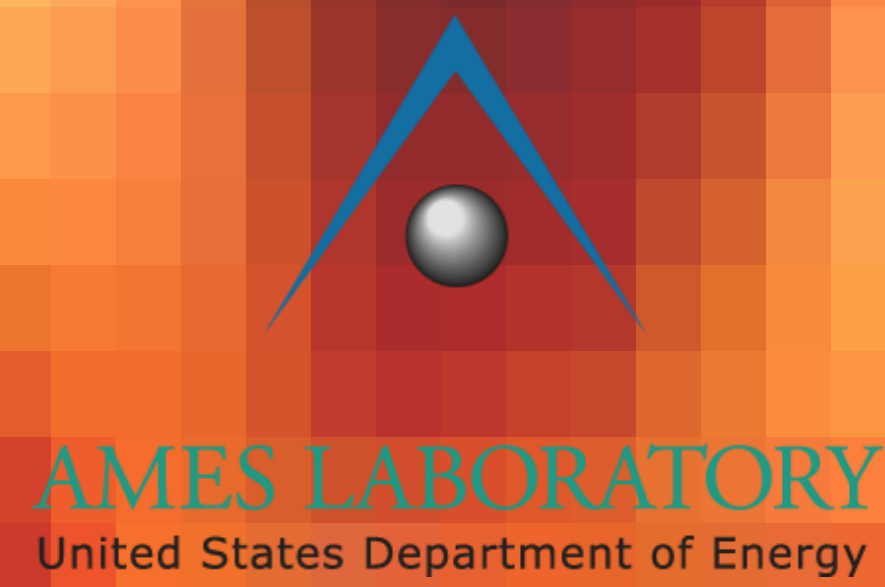
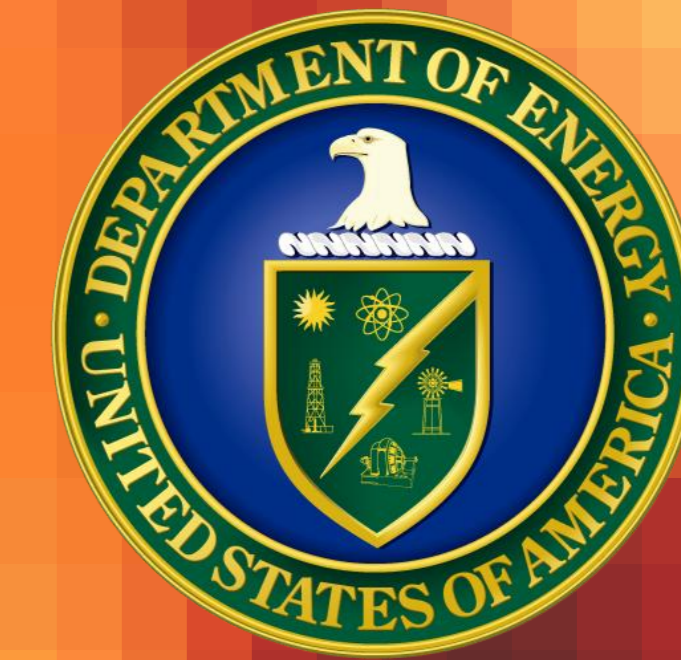


http://www.chem.qmul.ac.uk/surfaces/scc/scat1_2.htm

Depositing Sulfur on Ag(100) -Silver- Under Very Low Pressure

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ABSTRACT

Using a very low pressure chamber, 1×10^{-16} atmospheres, the surface of a 2 mm x 5 mm sample of silver, Ag(100) is prepared and sulfur is deposited. An even layer was seen on the sample. After heating and cooling cycles, square patterns appeared at different levels, of different sizes, in different orientations, and of different textures.

BACKGROUND

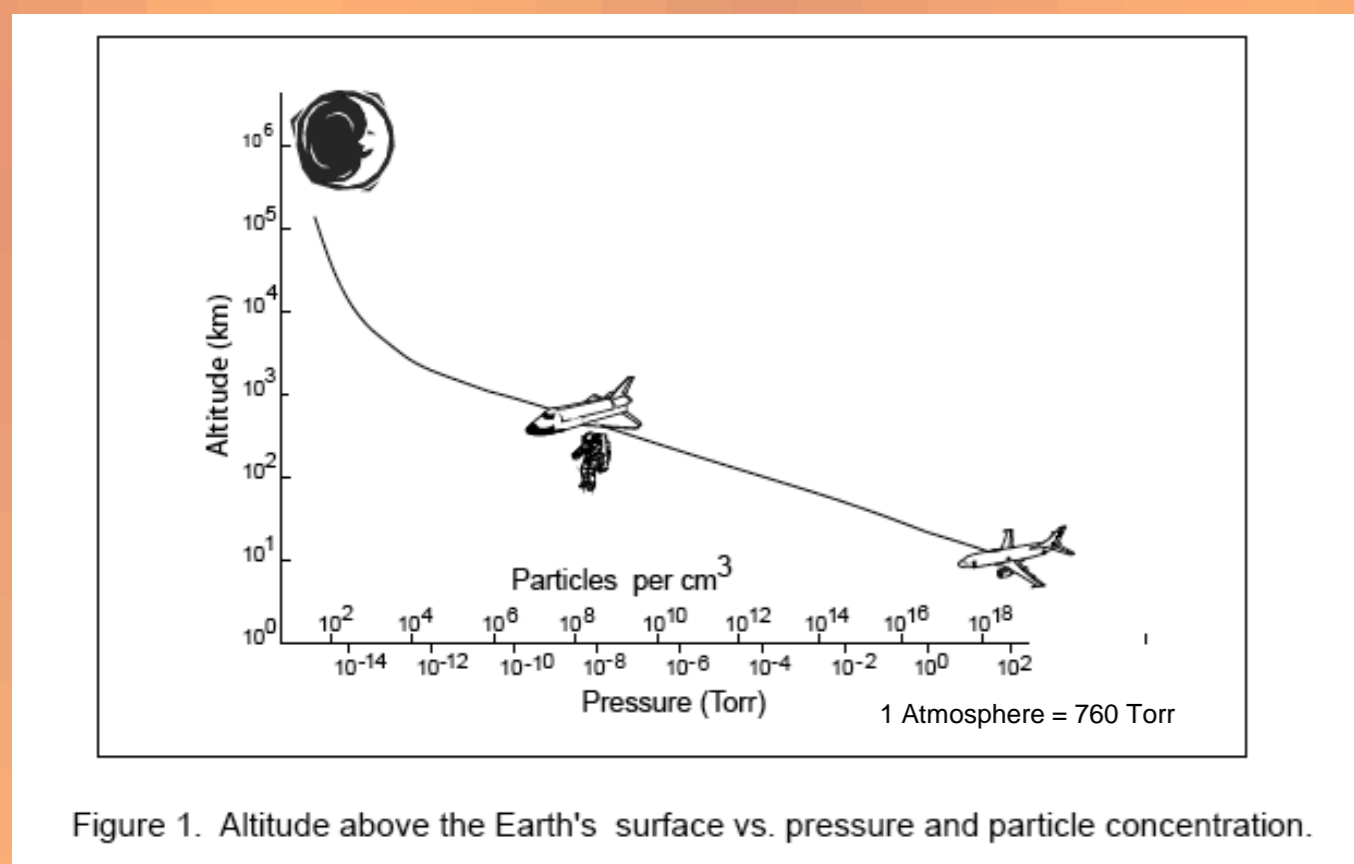
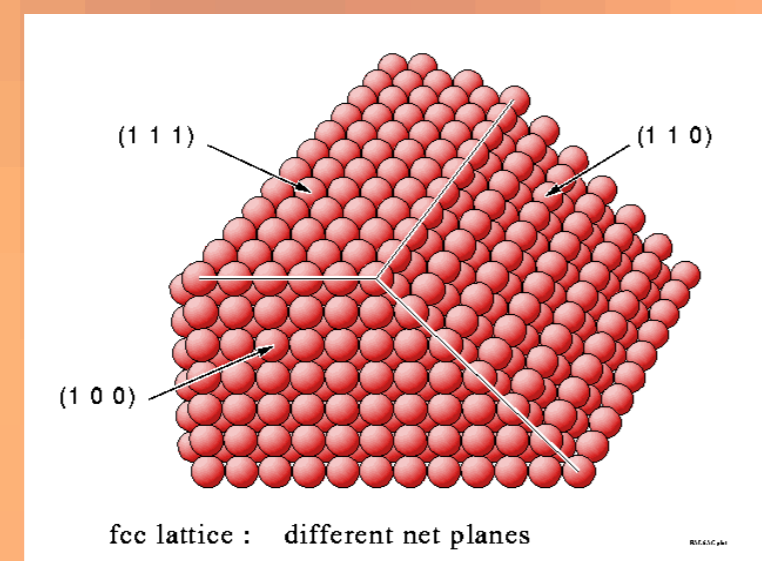


Figure 1. Altitude above the Earth's surface vs. pressure and particle concentration.



Atoms in metals are arranged in crystals and are identified by their x, y, and z axis. The crystalline structure determines the properties of the metal.

All matter is made of atoms. Each atom has protons, neutrons, and electrons. Atoms or their smaller components cannot be seen with the naked eye, but with a scanning tunneling microscope (STM) a "map" of the surface can be created. In a vacuum greater than what is experienced in space, electrons are "tunneled" between the tip and the surface. Then a computer creates a topographical image of the surface. Lowering the pressure removes as much air and other impurities as possible so that nothing will interfere with depositing the sulfur on the surface of the silver. When viewed in this close-up image, using a scanning tunneling microscope, the crystalline structure of metals can be seen.

RESEARCH QUESTION

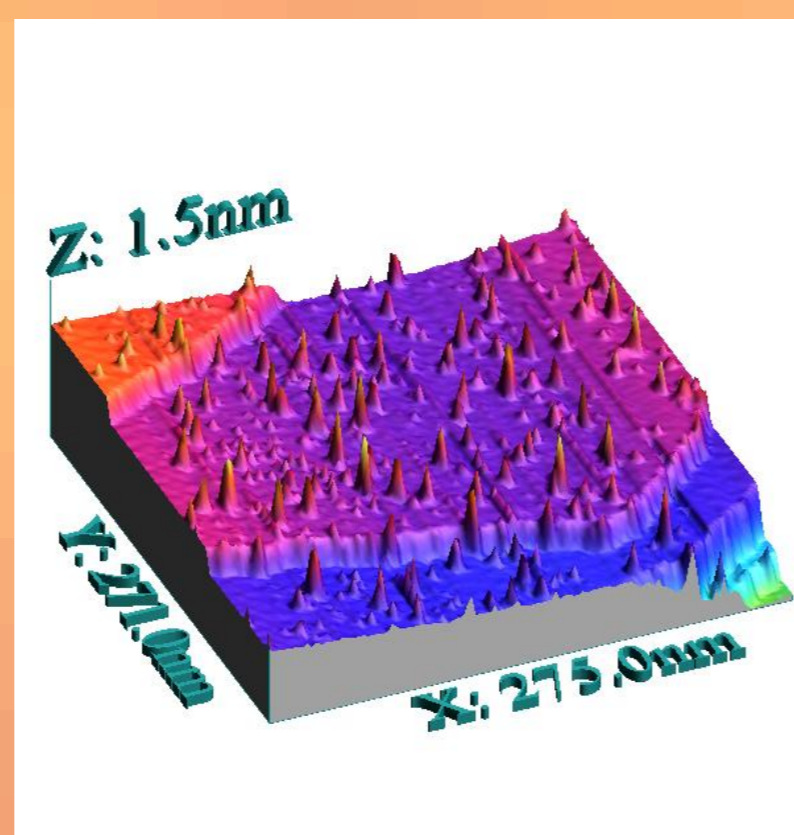
When sulfur is deposited on Ag100 under very low pressure, what kind of pattern, if any, will be created? Will silver and sulfur create a crystalline pattern?

METHODS

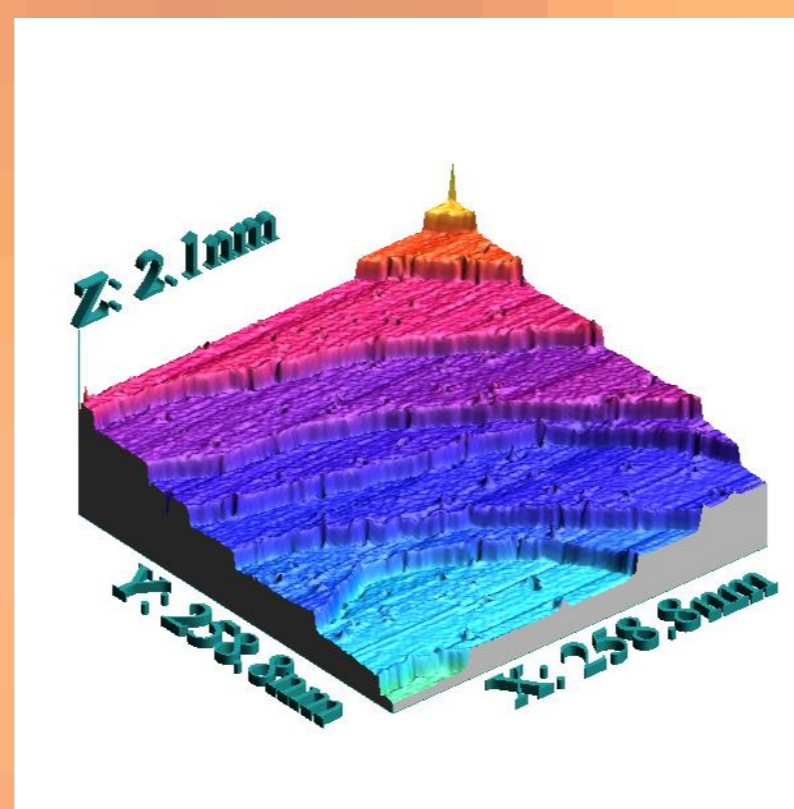
First, a 2 mm x 5 mm sample of silver was mounted in the main chamber of a very low pressure unit. The pressure is reduced with a series of pumps to 10^{-16} ATM. Then the sample undergoes sputtering which uses argon ions to bombard the surface of the silver to remove unwanted particles, like oxides. Next, annealing heats the sample to 800 K which is near the melting point of silver at 1200 K. Heating the sample increases energy and atoms move faster, filling in gaps and leveling layers. Then the scanning tunneling microscope (STM) uses electrons to produce a computer image of the atoms on the surface of the silver sample.

When the sample meets acceptable standards, sulfur vapor is deposited on the silver. Again the STM sends many topographical images to the computer to create a representation of the surface of the silver including the blanket of sulfur. Repeated images are created over several hours at temperatures between 110 K and 300 K.

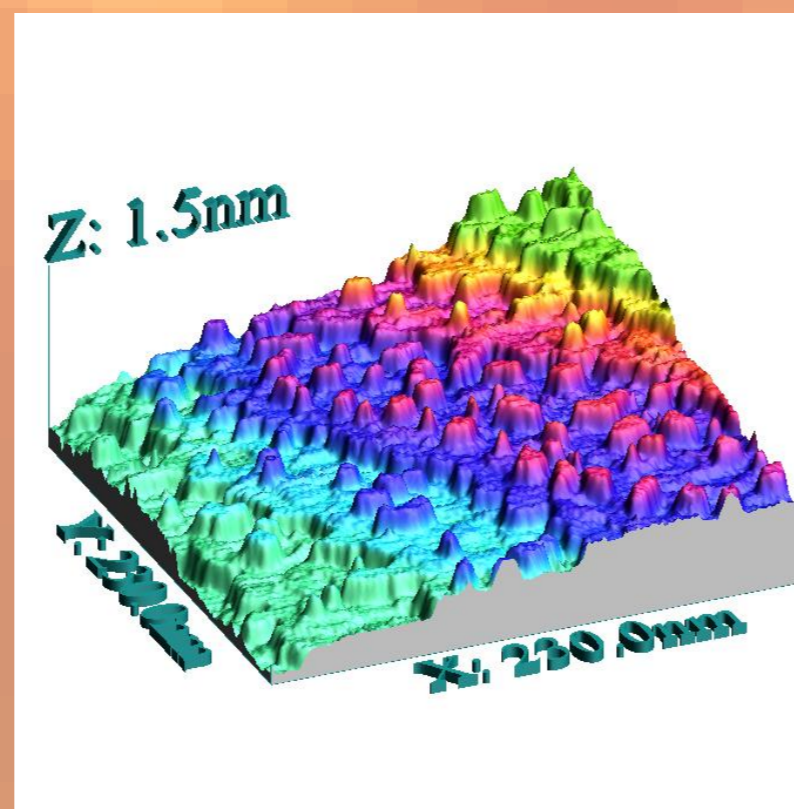
RESULTS



Ag(100) surface shows oxides and other contaminants as tiny peaks along the terraces of the silver. Each terrace is one atom high.

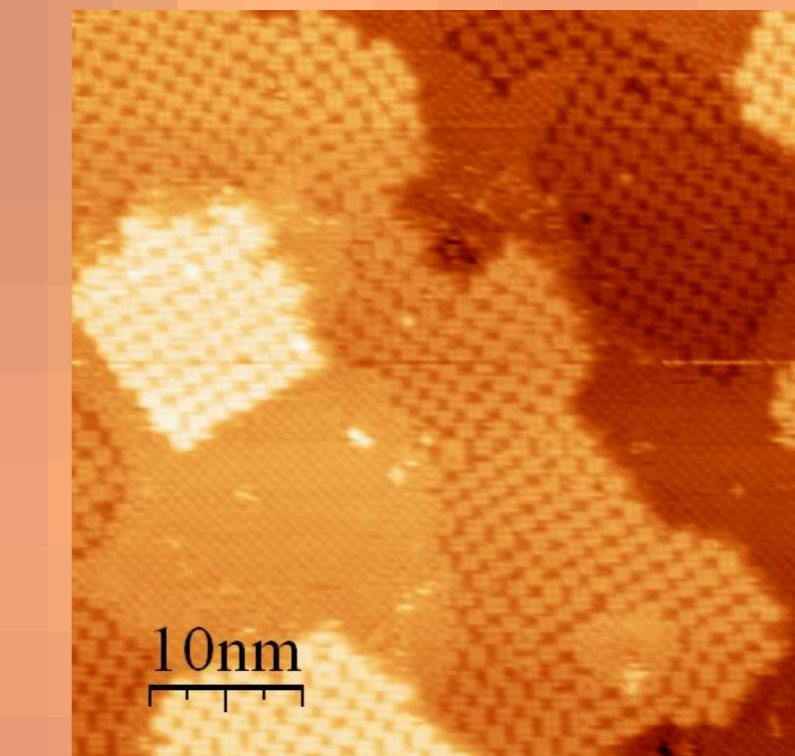


Following sputtering and annealing, the surface of the silver is mostly free of oxides. Black dots are pits in the silver created by gaps in the atoms.



Sulfur deposition was completed and the surface was heated and cooled to observe how the silver and the sulfur reacted to make patterns.

DISCUSSION



A two-dimensional analysis of the Ag(100) sample following deposition showed an even coating of sulfur. After a series of heating and cooling cycles, patterns began to form and change with the differences in temperature.

Most noticeable were the square patterns of atoms that took on different orientations in the sample. Also, some of the squares appeared fairly coarse in texture and others, very fine. Various terrace heights could also be seen. Areas of further research would include low-energy electron diffraction (LEED) and Auger electron spectroscopy to see greater detail of the response between the Ag(100) and sulfur.

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